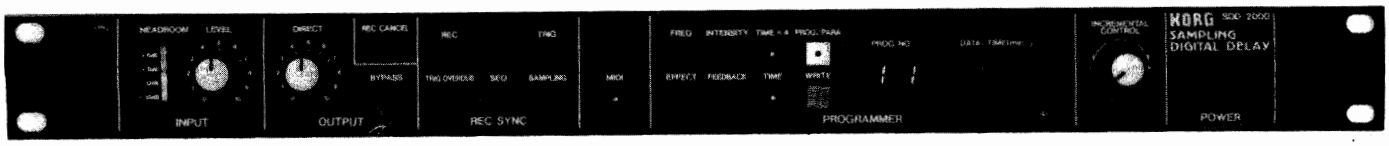
KORG®

DIGITAL DELAY
SDD-2000



SERVICE MANUAL

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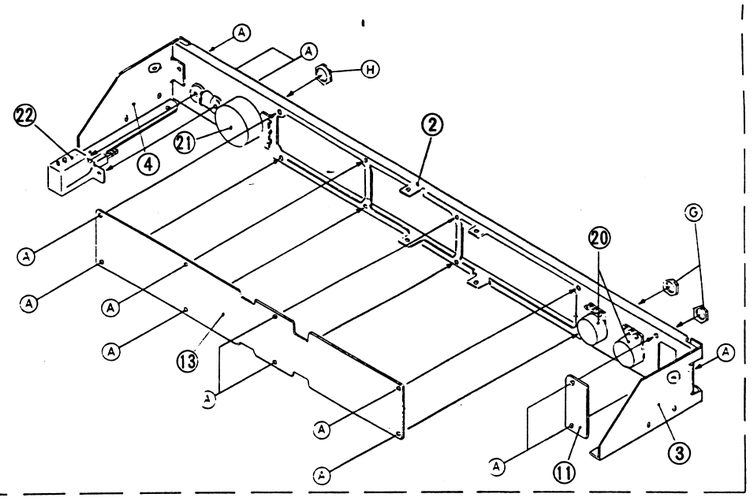
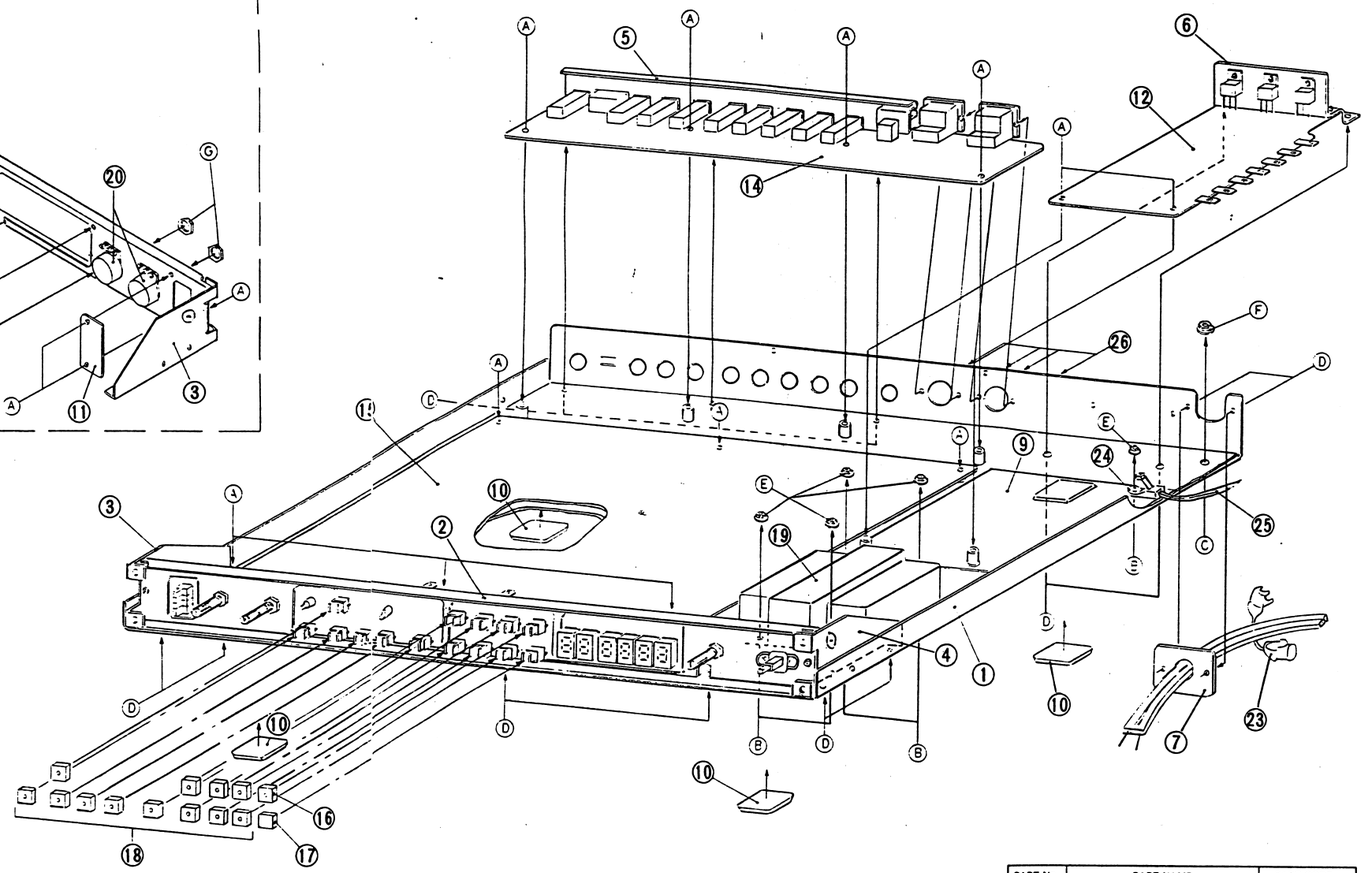
KEIO ELECTRONIC LABORATORY CORPORATION
TOKYO/JAPAN

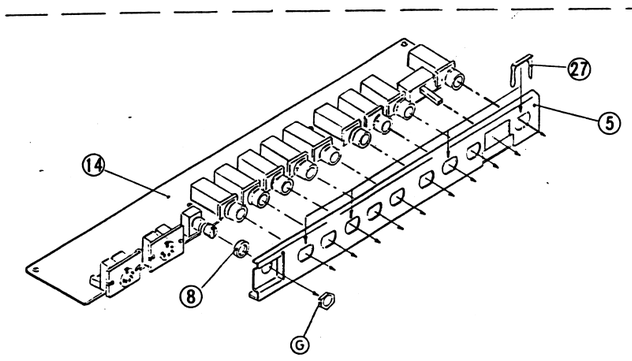
1. SPECIFICATIONS

- **Input**
  - Input level: −35dBm / −10dBm
  - Impedance: 47kΩ / 500kΩ
  - Max clip level: +6dBm / +19dBm
- **Output (Unity)**
  - Output level: −35dBm / −10dBm
  - Impedance: 600Ω / 600Ω / 600Ω / 600Ω
  - Max clip level: −20dBm (Direct) / −20dBm (Effect) / +6dBm (Direct) / +3dBm (Effect)
- **Frequency response**: 20Hz ~ 20KHz, ±1dB (Direct)
  30Hz ~ 18KHz, +1dB, −3dB (Effect) (X1 mode)
  30Hz ~ 4.5KHz, +1dB, −3dB (Effect) (X4 mode)
- **Dynamic range**: 90dB (IHF) (Effect) or more
  95dB (IHF) (Direct) or more
- **S/N ratio**: 80dB (IHF) (Effect)
- **Distortion**: 0.05% (Direct)
  0.1% (Effect)
- **Delay time**: 0 ~ 4368msec (1msec step)
  0 ~ 1092msec (1 ~ 10msec – 1msec step) (X1 mode)
  0 ~ 4368msec (X4 mode)
- **Feedback**: 63 steps
  0 ~ 31 (Positive phase) 0: 0%, 33: 110%
  0 ~ −31 (Opposite phase) 0: 0%, −31: 110%
- **Modulation**: Waveform: Triangle wave (/\)
  Modulation frequency: 0.1Hz ~ 10Hz (Frequency 0: 0.1Hz, 31: 10Hz)
  Delay time modulation range: 2:1 (Intensity 31)
- **Dimensions**: 482 (W) X 44 (H) X 344 (D) mm
- **Weight**: 4.5kg
- **Power supply voltage**: AC100V, 50/60Hz
- **Power consumption**: 17W
- **Accessories**: Rack mounting kit (4 screws, 4 washers)
- **Options**: Signal cord, MIDI cable, Foot SW (PS-1, S-2), IU rack case

2. STRUCTURAL DIAGRAM

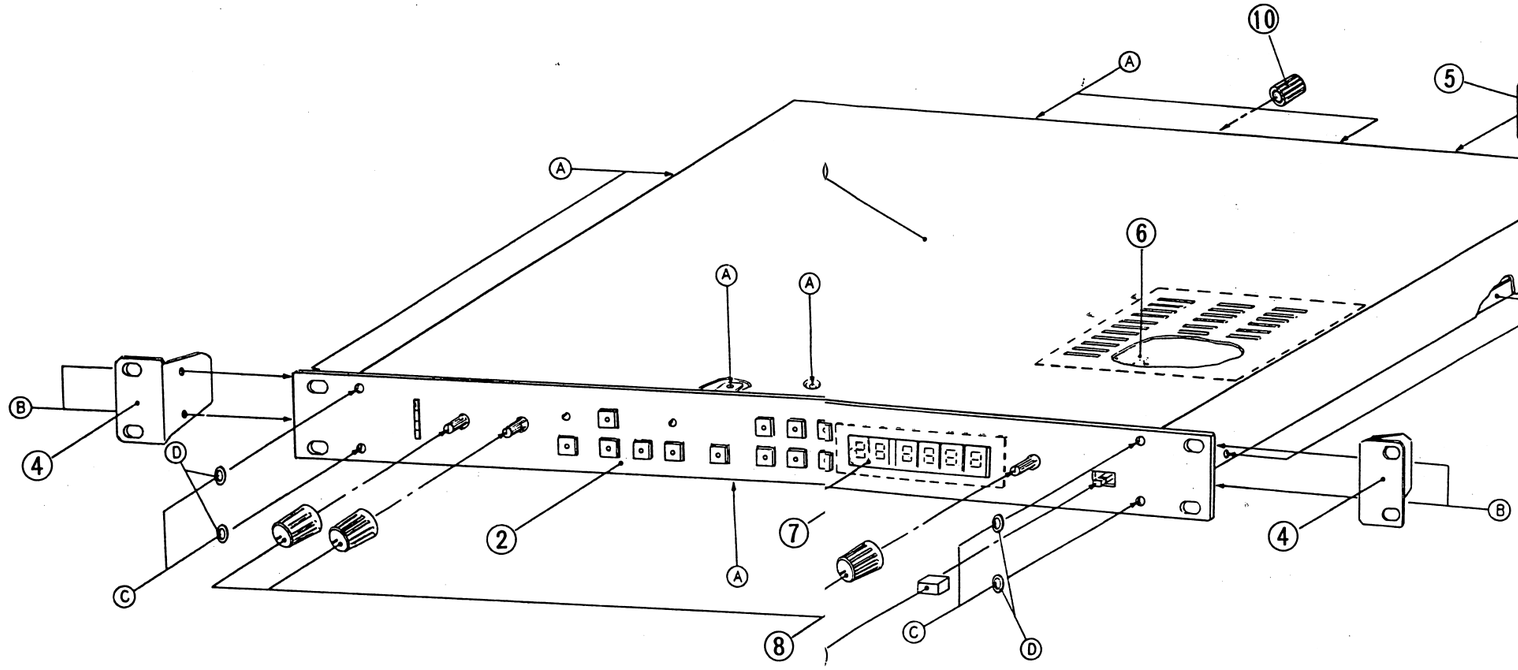






PART No.	PART NAME	Q'TY
A	FE 8 3x6 ZMC	26
B	FE 8 3x10 BZMC	5
C	FE 8 4x8 BZMC	1
D	TP2GB 3x6 BZMC	13
E	FHN 3 ZMC	5
F	FHN 4 ZMC	1
G	VN 7 ZMC	3
H	VN 9 ZMC	1

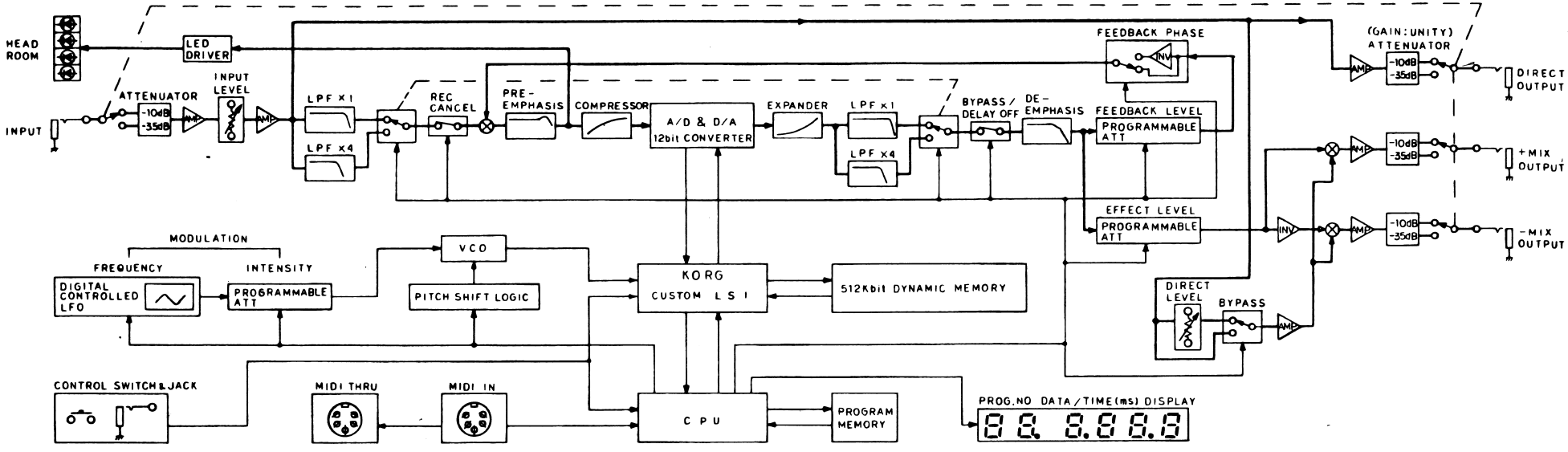
PART No.	PART NAME	PART CODE
1	CHASSIS	64069300
2	FRONT CHASSIS	64069400
3	METAL FITTING OF FRONT PANEL L	64063600
4	METAL FITTING OF FRONT PANEL R	64063601
5	METAL FITTING OF PHONE JACK	64069600
6	HEAT SINK	64063800
7	METAL FITTING OF BUSHING	64064000
8	VR HOLDER	79022102
9	SHIELDING PLATE	63000300
10	RUBBER FEET	50007800
11	KLM-825	34082510
12	KLM-829	34082910
13	KLM-831	34083100
14	KLM-832	34083200
15	KLM-833	34083300
16	TACT SW KNOB	62011001
17	TACT SW KNOB	62011202
18	TACT SW KNOB	62011000
19	POWER TRANSFORMER TA-802 TB-802	40008900 40009000
20	VR	36019100
21	ROTARY ENCODER	37003100
22	POWER SW	37508100
23	BUSHING	
24	WIRE BAND	54005300
25	WIRE BAND	54007100
26	PLASTIC RIVET	54011000
27	SNAP PLATE	45402400

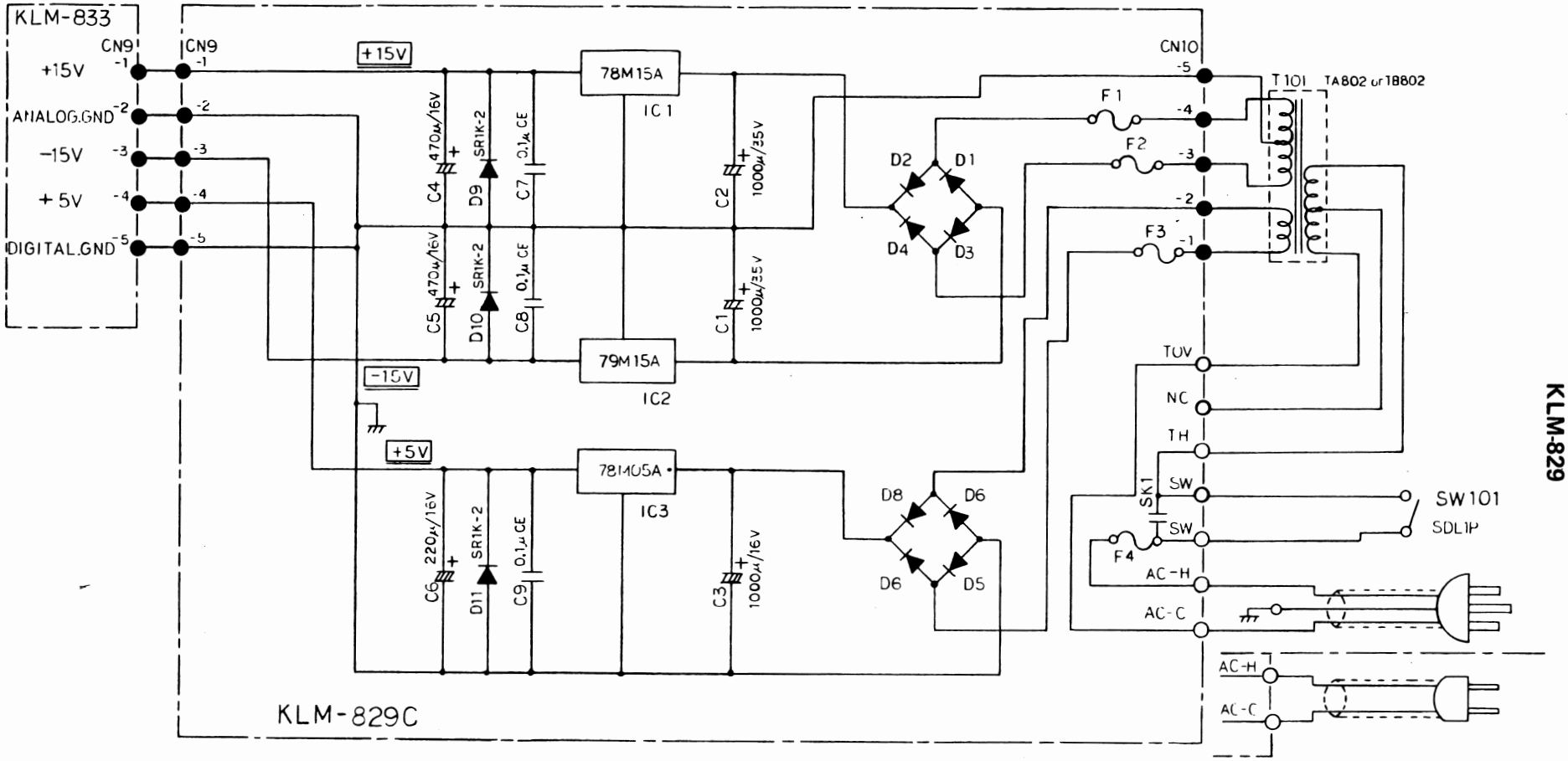


PART No.	PART NAME	Q'TY
A	TP2G B 3x6 BZMC	11
B	TP2G F 3x8 BZMC	4
C	FE HS 4x8 BZMC	4
D	WK 4 BZMC	4

PART No.	PART NAME	PART CODE
1	CHASSIS	64069300
2	FRONT PANEL	64069200
3	COVER	64069500
4	FRONT PANEL BOARD	64063700
5	NAME PLATE	68600700
6	RADIATION MASK	55005100
7	LED FILTER	63001000
8	VR KNOB	62013200
9	POWER SW KNOB	62011100
10	ROTARY VR (SW) KNOB SMALL	62007400

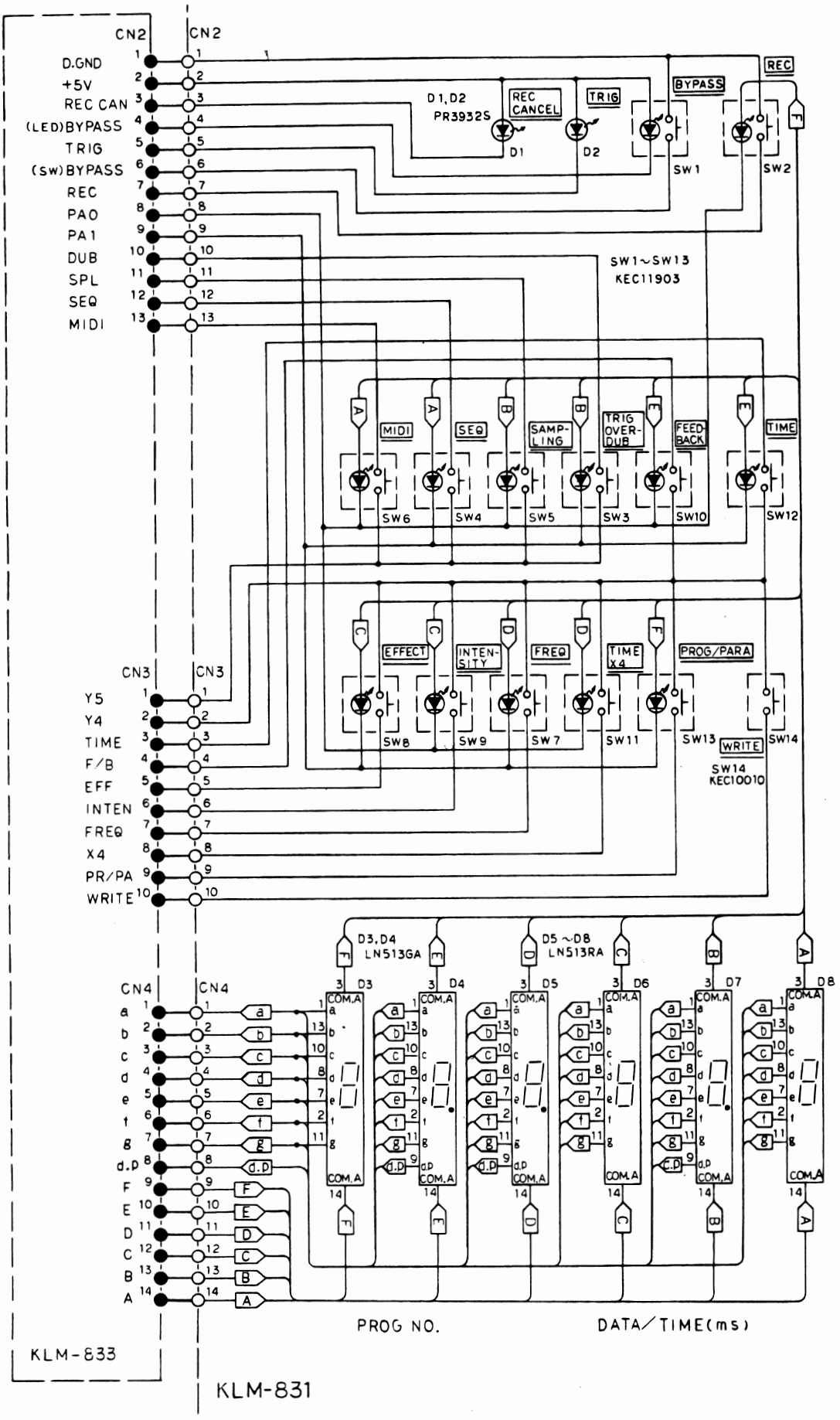
3. BLOCK DIAGRAM



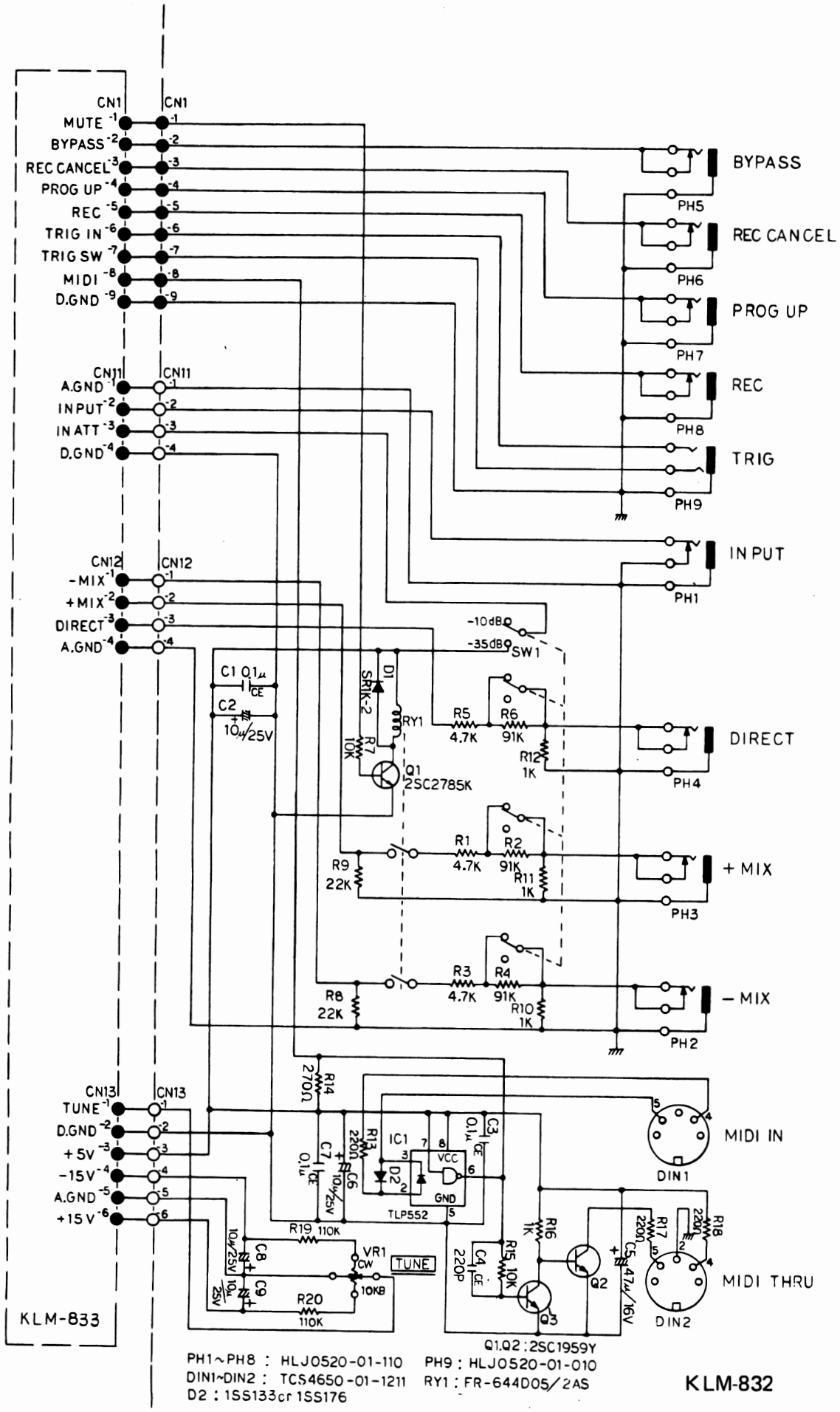


SK1 : PME265MC533
D1~D8 : SR1K-2

	F1, F2	F3	F4	T101
100V 117V	250V 1A	125V 2A	250V 0.5A	TA-802
220V 240V	250V.T500mA	250V. T1A	250V.T315mA	TB-802


CN2
D.GND
+5V
REC CAN
(LED)BYPASS
TRIG
(SW)BYPASS
REC
PA0
PA1
DUB
SPL
SEQ
MIDI
D1,D2
PR3932S
REC CANCEL
TRIG
BYPASS
REC
D1
D2
SW1
SW2
SW1~SW13
KEC11903
MIDI
SEQ
SAMP-LING
TRIG OVER-DUB
FEED-BACK
TIME
SW6
SW4
SW5
SW3
SW10
SW12
EFFECT
INTEN-SITY
FREQ
TIME X4
PROG/PARA
WRITE
SW8
SW9
SW7
SW11
SW13
SW14
SW14
KEC10010
CN3
Y5
Y4
TIME
F/B
EFF
INTEN
FREQ
X4
PR/PA
WRITE
CN4
a
b
c
d
e
f
g
d.p
F
E
D
C
B
A
D3,D4
LN513GA
D5~D8
LN513RA
D3
D4
D5
D6
D7
D8
COM.A
PROG NO.
DATA/TIME(ms)
KLM-833
KLM-831

KLM-832


CN1
MUTE
BYPASS
REC CANCEL
PROG UP
REC
TRIG IN
TRIG SW
MIDI
D.GND
CN11
A.GND
INPUT
IN ATT
D.GND
CN12
-MIX
+MIX
DIRECT
A.GND
CN13
TUNE
D.GND
+5V
-15V
A.GND
+15V
KLM-833
BYPASS
PH5
REC CANCEL
PH6
PROG UP
PH7
REC
PH8
TRIG
PH9
IN PUT
PH1
-10dB
-35dB
SW1
C1 0.1μ
C2 10μ/25V
D1 SR1K-2
RY1
R7 10K
Q1 2SC2785K
R5 4.7K
R6 91K
R12 1K
DIRECT
PH4
R1 4.7K
R2 91K
R9 22K
R11 1K
+ MIX
PH3
R3 4.7K
R4 91K
R8 22K
R10 1K
- MIX
PH2
R14 270Ω
IC1
TLP552
D2
C3 0.1μ
C7 0.1μ
C6 10μ/25V
R13 220Ω
R19 110K
VR1 10KB
TUNE
C8 10μ/25V
C9 10μ/25V
R20 110K
MIDI IN
DIN1
R16 1K
R15 10K
C4 220P
Q2
Q3
R17 220Ω
R18 220Ω
C5 47μ/16V
MIDI THRU
DIN2
Q1,Q2 : 2SC1959Y
PH1~PH8 : HLJ0520-01-110
PH9 : HLJ0520-01-010
DIN1~DIN2 : TCS4650-01-1211
RY1 : FR-644D05/2AS
D2 : 1SS133 or 1SS176
KLM-832

6. CIRCUIT DESCRIPTION

1. KLM-833 Analog Circuit

Audio signal route

Level of Audio signal input from Connector CN-11 pin 2 is decided by Relay RY1 which is controlled by Attenuator SW. Level of Audio signal amplified by 1/2 IC31 is changeable by Input Level VR (VR101). Audio signal re-amplified by 1/2 IC31 (4558) is sent to each of (1) 2 kinds of Low-pass filter LPF-1, LPF-2 (2) Direct Out VR102, 1/2 IC36 and (3) Q24.

Q24 is amplifier for trigger controlled by Audio signal sending trigger signal to CPU port PA7 (IC23, pin 8) while sampling and start sampling according to Audio signal level.

IC35 is an Analog Switch selecting which Audio signal will be output, one from LPF-1, one from LPF-2 or no signal (=OFF). This IC is controlled by Gate Array. In this case, OFF is selected to off Audio signal and make Audio signal not to be sent to A/D while REC CANCEL. This IC35 is controlled by Gate Array IC22 pin 29 (SOFF terminal). (SOFF terminal is "L" while REC CANCEL)

Selecting of LPF-1, LPF-2 is made by CPU IC23. This is, CPU address is decoded by decoder IC56 and let IC47 latch data. Filter selecting signal is controlled by IC47 latch output pin 15. When delay time mode is x 4, this terminal comes to be "H" and LPF-1 (4.5KHz) is selected.

1/2 IC33 (Pin 1,2,3) works as Pre-emphasis, and Mix Amp of FEED BACK and 1/2 IC33 (Pin 5,6,7), IC32, IC37 work as Analog Compander (Compressor+Expander) and Audio signal.

1/2 IC13 is an Analog Switch and works as a Bypass Switch of Analog Compander Circuit. This IC is controlled by pin 27: COMP Terminal of Gate Array IC22. ("L" at Delay, "H" at Sampling, Sequencer)

While sampling, it lets compressed Audio signal bypass Analog Compander Part not to have compressing error. Output signal (LCOM terminal) of IC13 is output as A/D signal to Digital Circuit.

D/A signal once digitalized in Digital Circuit changes to Analog signal after through D/A and is input to IC29, IC32. IC32 constructs Expander with 1/2 IC34, and IC37.

IC29 constructs Audio Muting Circuit with IC30. 1/2 IC13 is an Analog Switch and works with Compander to make Audio signal bypass Expander while Sampling.

IC 29: Signal Muting Circuit is VCA which has time constance in order not to generate Noise at signal sudden ON/OFF and smoothen Audio signal while sampling. This IC works with control signal from CPU PA6 terminal letting IC30 drive VCA.

IC39 is an Analog Switch selecting which Audio signal will be output, one from LPF-3, one from LPF-4 or no signal (=OFF). OFF is selected in order to off delay sound while REC SYNC SW is ON (Sampling, Sequencer, Trigger Overdub are ON). When those Switches are ON, Gate Array IC22 pin 28 (DOFF terminal) becomes "H" and off output from IC39.

The signal which passes IC39 is de-emphasized at 1/2 IC40 (pin 5,6,7) and go into EFFECT Volume Control Circuit and FEED BACK Volume Control Circuit.

A) EFFECT Volume Control Circuit
EFFECT Level data from CPU DATA BUS D0 – D7 is latched by IC44 and IC44 lets Analog switches IC45, IC46 control Block R. RM8 to decide EFFECT level.

B) FEED BACK Volume Control
FEED BACK Level Data of CPU DATA BUS is latched by IC41 and IC41 lets Analog Switches IC42, IC43 control Block R. RM7 to decide FEED BACK level.

Phase of FEED BACK signal output from Block R. RM7 is inverted at 1/2 IC40 (pin 1,2,3).
Analog SW. IC42 selects if normal or inverted and the feedbacked signal is returned to IC35 output.
(Note: Analog Switch is controlled by CPU DATA latched by IC41.)

MODULATION PART

FREQ.
At 2/4 IC54 (pin 5,6,7 pin 8,9,10), Triangle Wave Oscillator Circuit is constructed. Data from CPU DATA BUS is latched by IC47 and IC47 Analog SW. IC49, IC48 control RM9 to decide oscillation frequency.

INTENSITY
Data from CPU DATA BUS DATA is latched by IC50 and lets Analog Switch IC51, 52 control Block R. RM10 to be working as attenuator in order to decide MG INT.

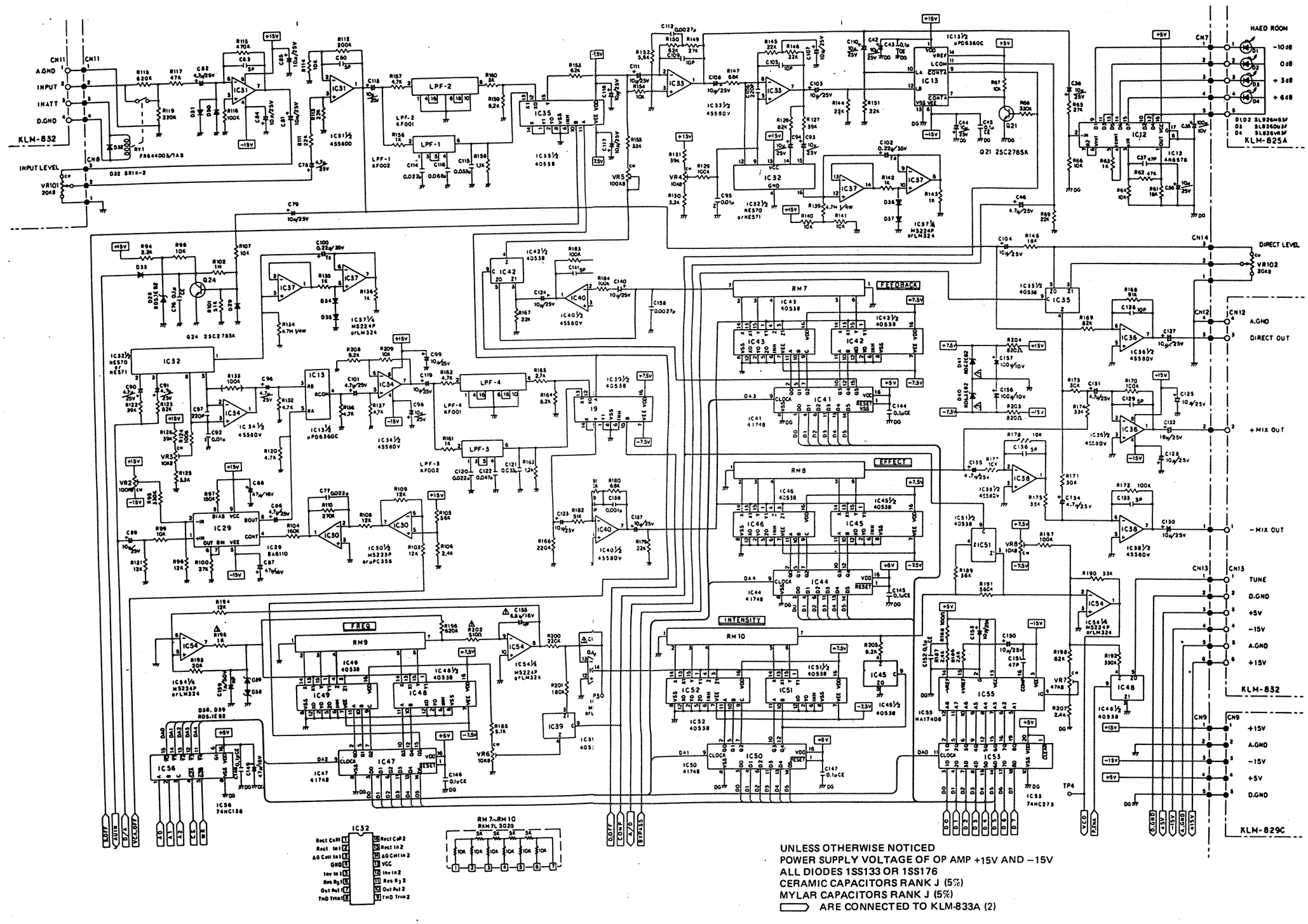
IC53 latches Scale Data which is from CPU DATA BUS By the latched data, IC55 works as D/A and input latched data to pin 2 of IC54 and mix with basic voltage to control VCO: IC21 which changes system clock.

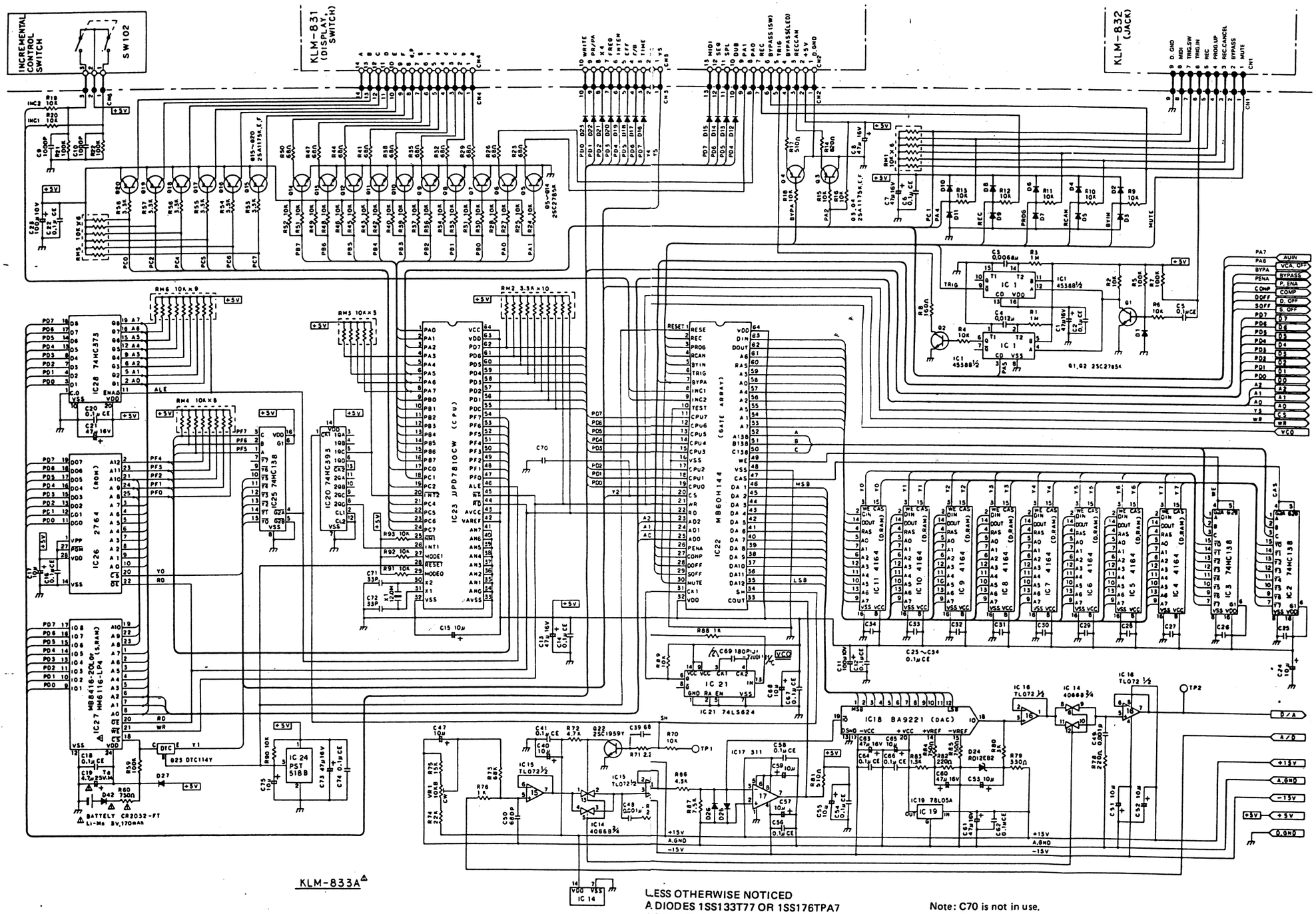
2. KLM-833 Digital Circuit

1) Audio Signal Path
A/D signal is made to be S/H by IC15 and 1/2 IC14. The signal made to be S/H is at IC17 and to be Digital signal after linearization (12bit) by D/A IC18 and Succesive Approximation Registers. And memorized into IC11 – IC14 accordingly.
IC3, IC2 (74HC138) are decoders.
Gate Array reads Delay value from DATA BUS of CPU and outputs address which accesses D-RAM. And output data from D-RAM returns to Gate Array and Gate Array controls IC18 to output D/A signal. Output data from D/A is made to be S/H at IC16, 1/2 IC14 and output to Analog Circuit as analog signal.

2) System Clock Path
VCO control D/C voltage is sent from Analog Circuit to IC21 pin 13. With the voltage, IC21 generates and supplies System Clock to IC22 pin 31. Gate Array IC22 produces Timing which controls each part of SDD-2000.

KLM-833 (1)


KLM-832
KLM-825A
KLM-829C
KLM-833A (2)
INPUT LEVEL
DIRECT LEVEL
FEEDBACK
EFFECT
FREQ
INTENSITY
HAED ROOM
DIRECT OUT
+MIX OUT
-MIX OUT
TUNE
Q21 2SC2785K
Q24 2SC2785K
UNLESS OTHERWISE NOTICED
POWER SUPPLY VOLTAGE OF OP AMP +15V AND −15V
ALL DIODES 1SS133 OR 1SS176
CERAMIC CAPACITORS RANK J (5%)
MYLAR CAPACITORS RANK J (5%)
ARE CONNECTED TO KLM-833A (2)



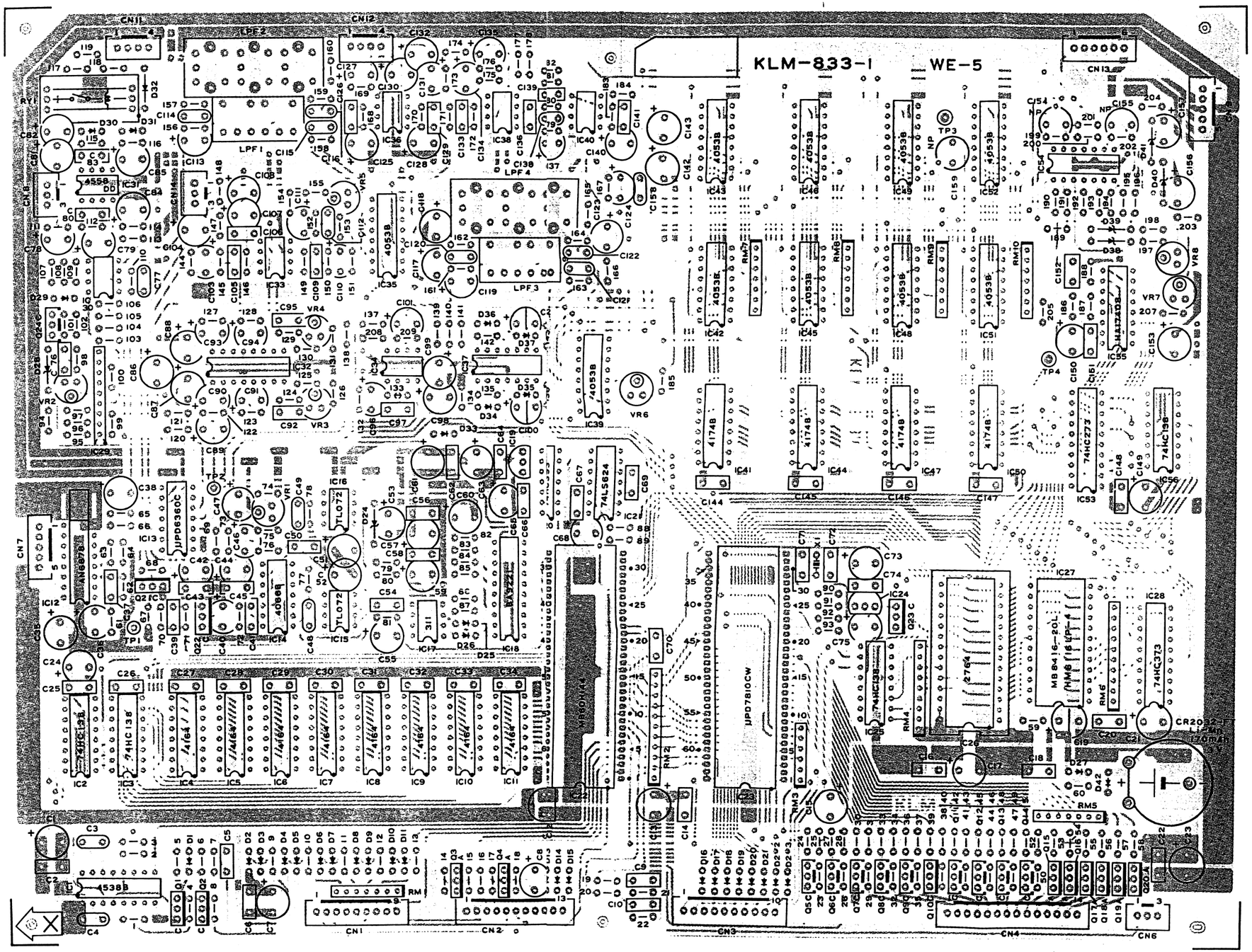
KLM-833A△

LESS OTHERWISE NOTICED
A DIODES 1SS133T77 OR 1SS176TPA7
A RESISTORS S 1/6 WJTP
A CERAMIC AND MYLAR CAPACITORS RANK K
CAMIC CAPACITOR 0.1μ CE RANK Z 25V PRESSURE POF
ECTROLYTIC CAPACITOR 10μ 25V PRESSURE PROOF

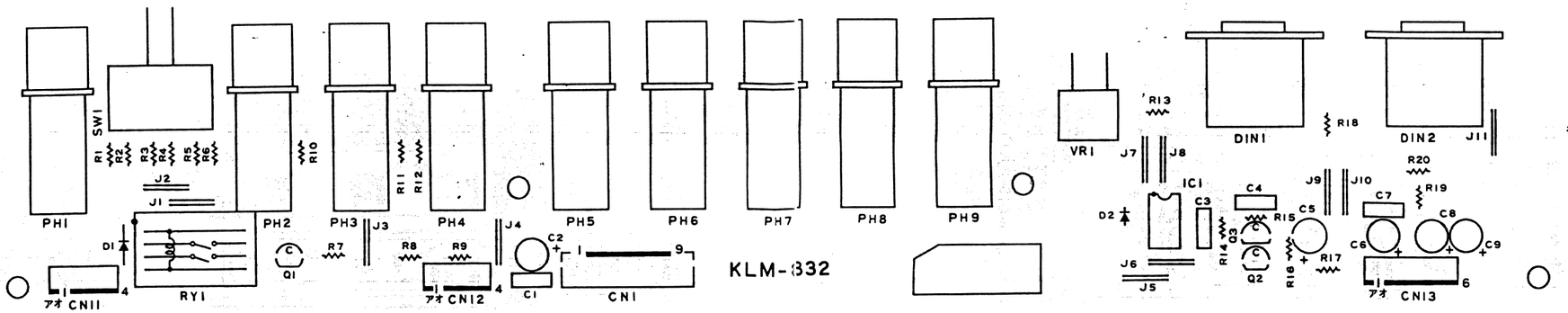
Note: C70 is not in use.
⬭ are connected to KLM-833A (1).

5. PC BOARD

KLM-833

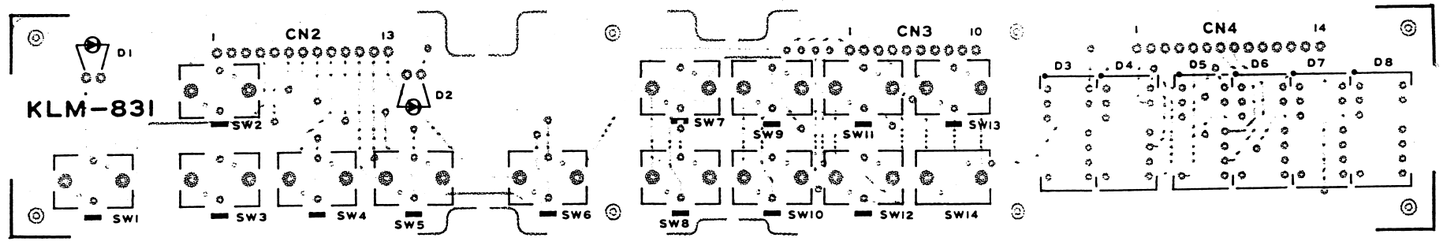


KLM-832

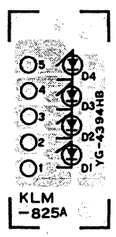


KLM-829

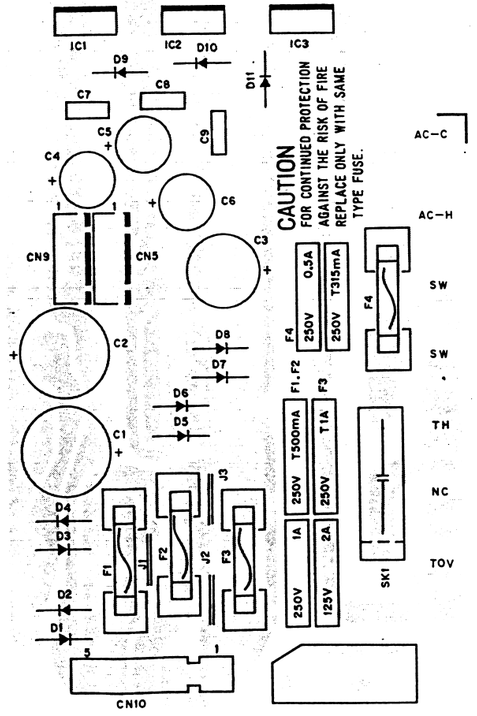
KLM-831



KLM-825



KLM-829-1



3) Switch, Control Part

Pulse signal sent from Incremental Controller controls Internal Counter of Gate Array and it sends Count value to CPU DATA BUS.

Waveform of the signal sent from Trigger Jack is shapened at Q1 and at One shot-Multi of IC1 reformed to pulse wave. LED displaying of Trigger signal ON/OFF is done by IC1 and Q2.

Input signals of MUTE, BYPASS, REC CANCEL, PROG. UP, REC TRIG SW. are input to Gate Array and sent to CPU as readable data.

MIDI signal is sent to and controlled by CPU.

Tact Switch on Front Panel is controlled by CPU.

4) CPU

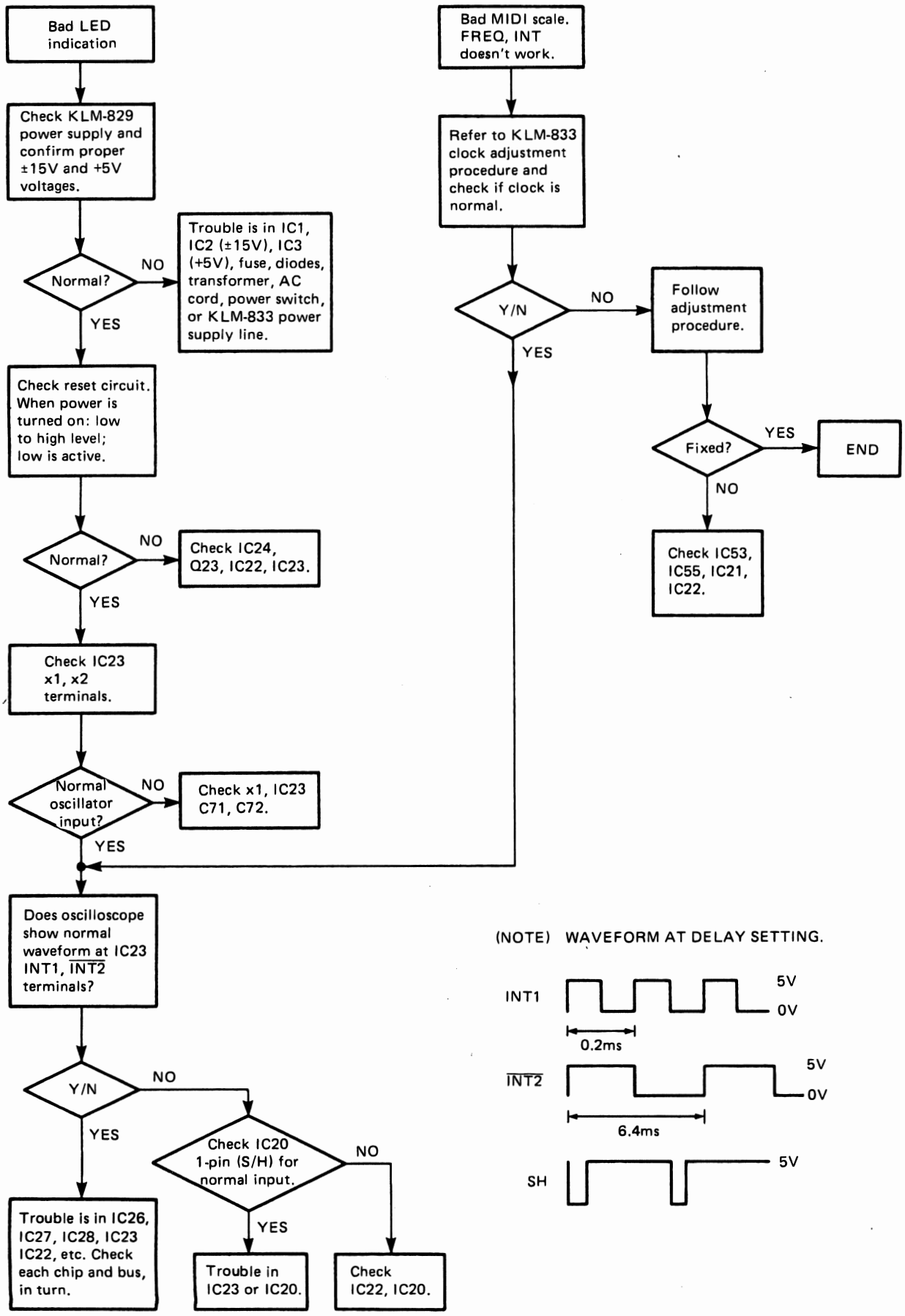
CPU connects IC28 (Latch), IC26 (ROM), IC27 (RAM) and IC22 (Gate Array) through decoder and controls each with DATA BUS.

IC20 Counter HC393 devides the signal (S/H) syncronizing with System Clock of Gate Array and sends it to CPU in order that CPU can read system clock.

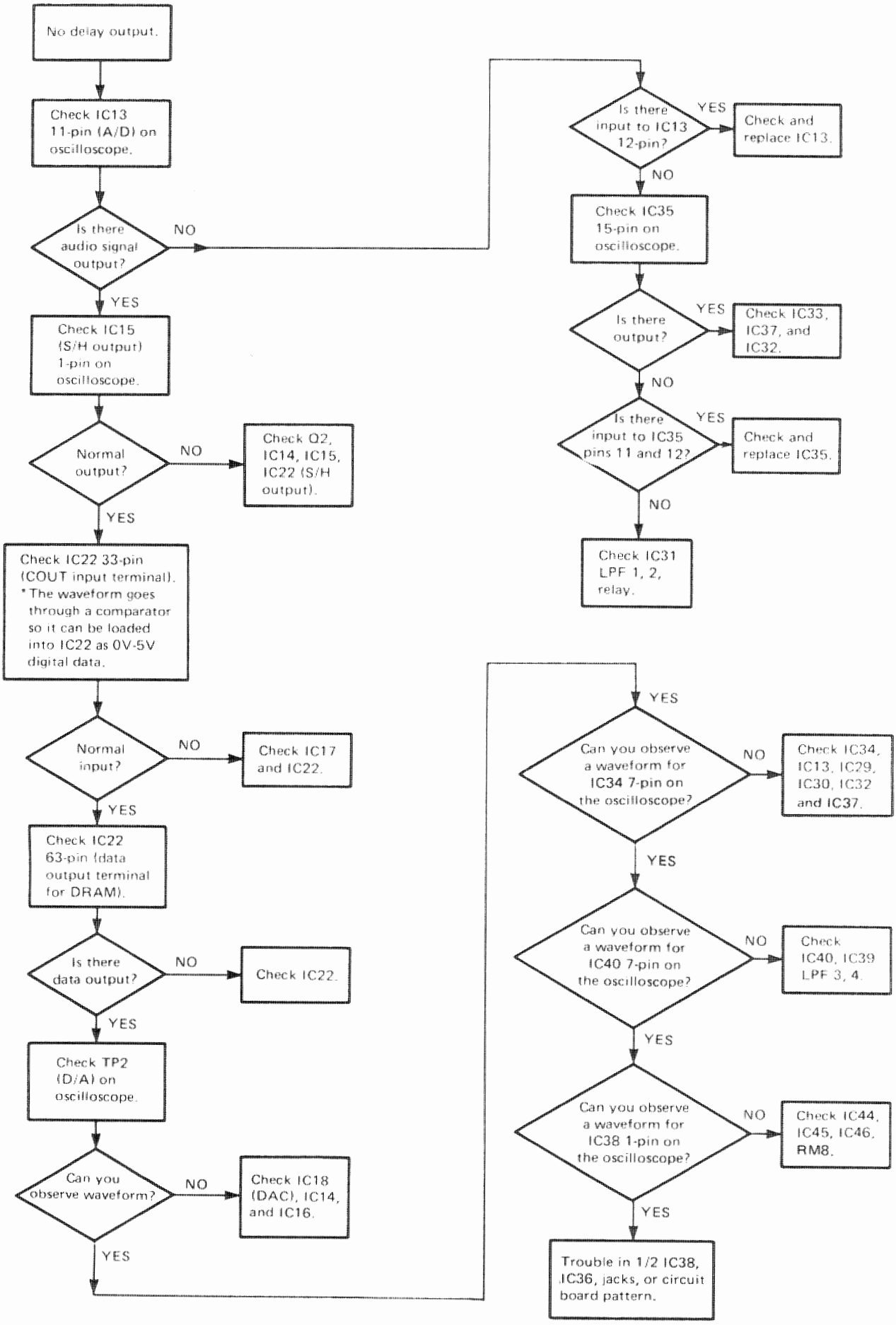
7. TROUBLESHOOTING CHART

Note:
Before servicing, make sure that all harnesses are plugged into their connectors.

Problem:


Bad LED indication
Check KLM-829 power supply and confirm proper ±15V and +5V voltages.
Normal?
NO
Trouble is in IC1, IC2 (±15V), IC3 (+5V), fuse, diodes, transformer, AC cord, power switch, or KLM-833 power supply line.
YES
Check reset circuit. When power is turned on: low to high level; low is active.
Normal?
NO
Check IC24, Q23, IC22, IC23.
YES
Check IC23 x1, x2 terminals.
Normal oscillator input?
NO
Check x1, IC23 C71, C72.
YES
Bad MIDI scale. FREQ, INT doesn't work.
Refer to KLM-833 clock adjustment procedure and check if clock is normal.
Y/N
NO
Follow adjustment procedure.
YES
Fixed?
YES
END
NO
Check IC53, IC55, IC21, IC22.
Does oscilloscope show normal waveform at IC23 INT1, INT2 terminals?
Y/N
NO
YES
Check IC20 1-pin (S/H) for normal input.
NO
YES
Trouble is in IC26, IC27, IC28, IC23 IC22, etc. Check each chip and bus, in turn.
Trouble in IC23 or IC20.
Check IC22, IC20.

(NOTE) WAVEFORM AT DELAY SETTING.


No delay output.
Check IC13 11-pin (A/D) on oscilloscope.
Is there audio signal output?
NO
YES
Check IC15 (S/H output) 1-pin on oscilloscope.
Normal output?
NO
Check Q2, IC14, IC15, IC22 (S/H output).
YES
Check IC22 33-pin (COUT input terminal).
*The waveform goes through a comparator so it can be loaded into IC22 as 0V-5V digital data.
Normal input?
NO
Check IC17 and IC22.
YES
Check IC22 63-pin (data output terminal for DRAM).
Is there data output?
NO
Check IC22.
YES
Check TP2 (D/A) on oscilloscope.
Can you observe waveform?
NO
Check IC18 (DAC), IC14, and IC16.
YES
Is there input to IC13 12-pin?
YES
Check and replace IC13.
NO
Check IC35 15-pin on oscilloscope.
Is there output?
YES
Check IC33, IC37, and IC32.
NO
Is there input to IC35 pins 11 and 12?
YES
Check and replace IC35.
NO
Check IC31 LPF 1, 2, relay.
YES
Can you observe a waveform for IC34 7-pin on the oscilloscope?
NO
Check IC34, IC13, IC29, IC30, IC32 and IC37.
YES
Can you observe a waveform for IC40 7-pin on the oscilloscope?
NO
Check IC40, IC39 LPF 3, 4.
YES
Can you observe a waveform for IC38 1-pin on the oscilloscope?
NO
Check IC44, IC45, IC46, RM8.
YES
Trouble in 1/2 IC38, IC36, jacks, or circuit board pattern.

8. CHECK AND ADJUSTMENT PROCEDURE

Caution:

a. This product has been adjusted completely at the factory before shipment.
Therefore, do not adjust any points other than those seemed necessary.

b. Wait at least 10 minutes after turning on the power before making any adjustments.

1) Clock check and adjustment – 1

a) Setting: (any program number OK) Set TUNE VR on rear panel to center.

ATT SW	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	0	0	0	0
D.TIME	INTENSITY	FREQ.	TIME x 4	MODE
0	0	0	OFF	DELAY

b) Connect frequency counter to TP1 test point of KLM-833 and observe frequency.

c) Check if value of the counter is 40kHz ± 100Hz.

d) Adjust VR8 to obtain above value if the observed value is out of above range.

2) Clock check and adjustment – 2

a) Setting: (any program number OK) Set TUNE VR on rear panel to center.

ATT SW	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	7	0	0	0
D.TIME	INTENSITY	FREQ.	TIME x 4	MODE
0	0	0	OFF	*

* OFF the MIDI SW. and record any sound with SEQ MODE.

b) Connect frequency counter to TP1 and observe frequency.

c) ON the MIDI SW. and play MIDI Keyboard such as POLY-800.

ex)

	Value on counter
C1 Key	10,000Hz
C2 Key	20,000Hz
C3 Key	40,000Hz
B3 Key	75,644Hz
Bend Up (Bend Range Max)	80,000Hz

Note:
MIDI Receive CH must be 1CH.
MIDI edit information must be X4 mode.
Support note range must be C1.

d) Confirm if the value on the counter is within 80KHz ±100Hz.

e) Adjust VR7 to obtain above value if the observed value is out of above range.

3) LFO check and adjustment

a) Setting: (any program number OK)

ATT SW	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	0	0	0	0
D.TIME	INTENSITY	FREQ.	TIME x 4	MODE
0	0	0	OFF	DELAY

b) Connect oscilloscope (0.5V/div, 0.5V/div, DC) to TP3 on KLM-833 and observe waveform described below.

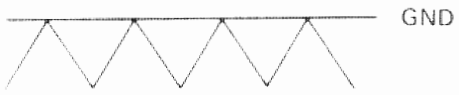


Fig. 1

c) Confirm if top of the waveform is 0V.

d) Adjust VR6 to obtain above waveform if observed waveform is different from the above description.

4) Maximum output level check and adjustment

a) Setting: (any program number OK)

ATT SW	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	7	*	*	0
D.TIME	INTENSITY	FREQ.	TIME x 4	MODE
0	0	0	OFF	DELAY

* any value OK

b) Connect standard signal generator (1KHz sine wave) to this unit's Input Jack.

c) Connect oscilloscope (2V/div, 50μsec/div, AC) to TP2 on KLM-833 and observe waveform described as below. To get the click waveform as below, adjust output volume of standard signal generator.

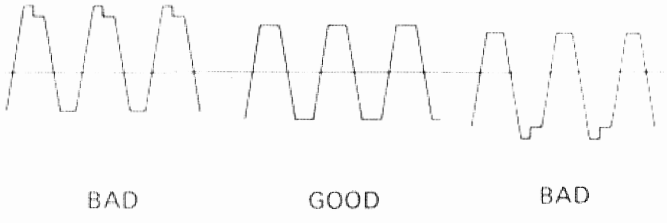


Fig. 2

d) Check if the observed waveform is GOOD. If not, adjust VR1 on KLM-833.

5) Analog Converter check and adjustment

a) Setting: (any program number OK)

ATT SW	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	7	0	22	0
D.TIME	INTENSITY	FREQ.	TIME x 4	MODE
0	0	0	OFF	DELAY

b) Input sine toneburst wave (=Sine Pulse Wave) (level: 10dBm, Freq.: 400Hz, width: 100msec) to Input Jack and observe EFFECT OUT with oscilloscope.

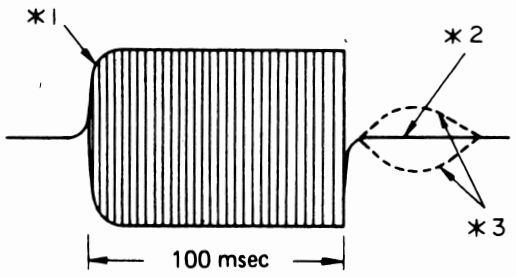


Fig. 3

c) When you cannot get correct waveform as above;
Adjust linearity at *3 with VR3, or adjust VR4 on KLM-833 to minimize DC drift in part *3 of the waveform. (*Description of the above figure is almost same as Service Manual for SDD-1000. Please refer to it.) (Page 16)

6) Feed back check and adjustment

a) Setting: (any program number OK)

ATT SW	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	7	0	22	30
D.TIME	INTENSITY	FREQ.	TIME x 4	MODE
120msec	0	0	OFF	DELAY

b) Connect oscilloscope (AC 0.5V/div, 0.5msec/div) to EFFECT OUT and confirm ringing when input sineburst wave (Freq.: 400Hz, width: 100msec) to Input Jack.
c) Set parameter value of FEED BACK to 28 and confirm no ringing when input the same sineburst wave as b).
d) Adjust VR5 not to generate ringing in case ringing occurs in above c).
e) Confirm if ....
no ringing occurs without any input.
ringing occurs with parameter value of FEED BACK is even -30±1 and phase changes.

7) VCA check and adjustment

a) Setting: (any program number OK)

ATT SW.	LEVEL VR	DIRECT VR	EFFECT	F.BACK
-10	7	0	31	0
TIME	INTENSITY	FREQ.	TIME x 4	MODE
0	0	0	OFF	SAMPLING

b) Input SG (sine wave of 1KHz, 2.5V P-P) to Input Jack and play sampling.
c) Connect MIDI Keyboard and playback sampling note. (play any key continuously)
d) Connect oscilloscope (DC 0.2V/div, 20msec/div) to EFFECT OUT and observe waveform as below.

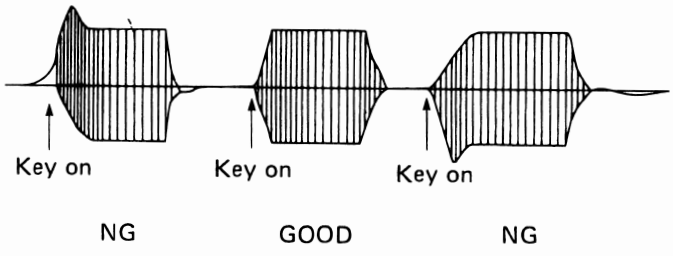


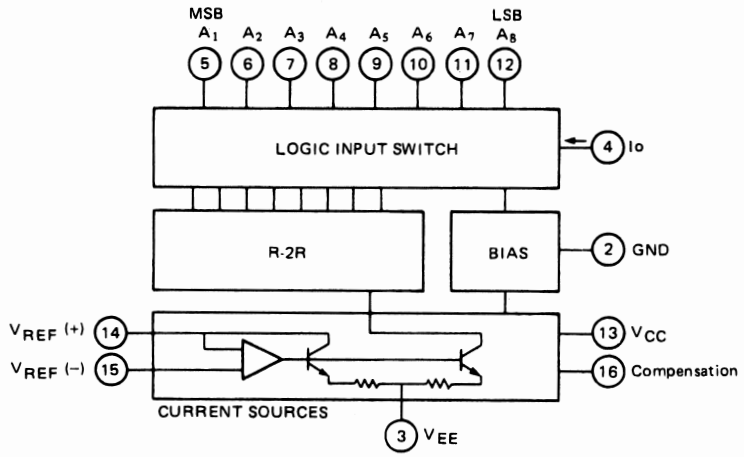
Fig. 4

e) Confirm if the observed waveform is GOOD. If not, adjust VR2 on KLM-833.

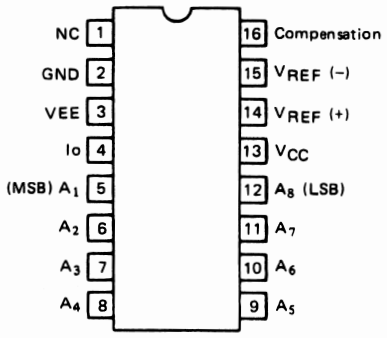
9. REFERENCE DATA

8 BIT D/A CONVERTER HA17408

BLOCK DIAGRAM

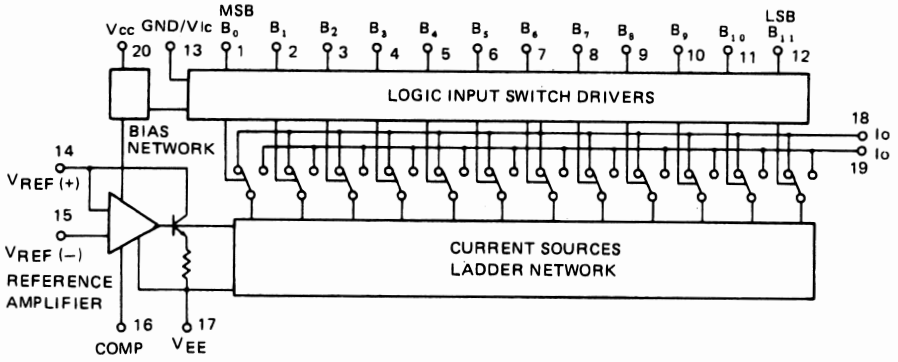


PIN CONFIGURATION

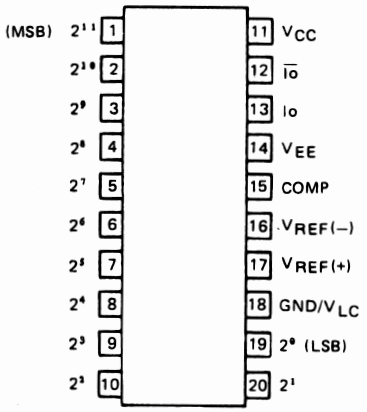


12 BIT D/A CONVERTER BA9221

BLOCK DIAGRAM

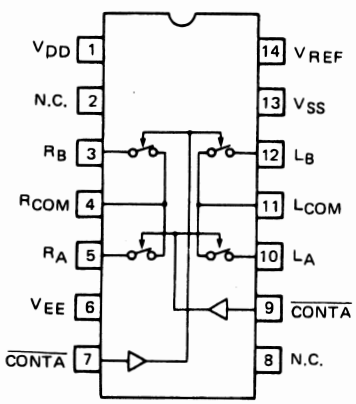

VCC GND/VIC MSB B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 LSB
20 13 1 2 3 4 5 6 7 8 9 10 11 12
LOGIC INPUT SWITCH DRIVERS
BIAS NETWORK
18 Io
19 Io
14
VREF (+)
15
VREF (−)
REFERENCE AMPLIFIER
CURRENT SOURCES LADDER NETWORK
16 COMP
17 VEE

PIN CONFIGURATION



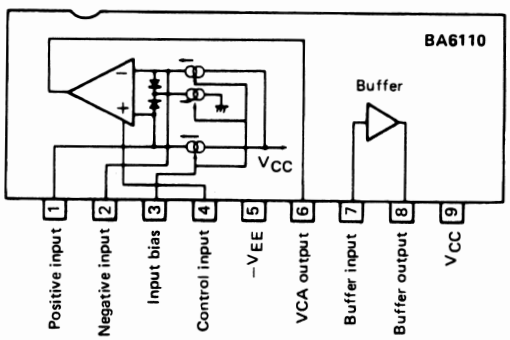
CMOS ANALOG SWITCH μPD6360C

BLOCK DIAGRAM, PIN CONFIGURATION



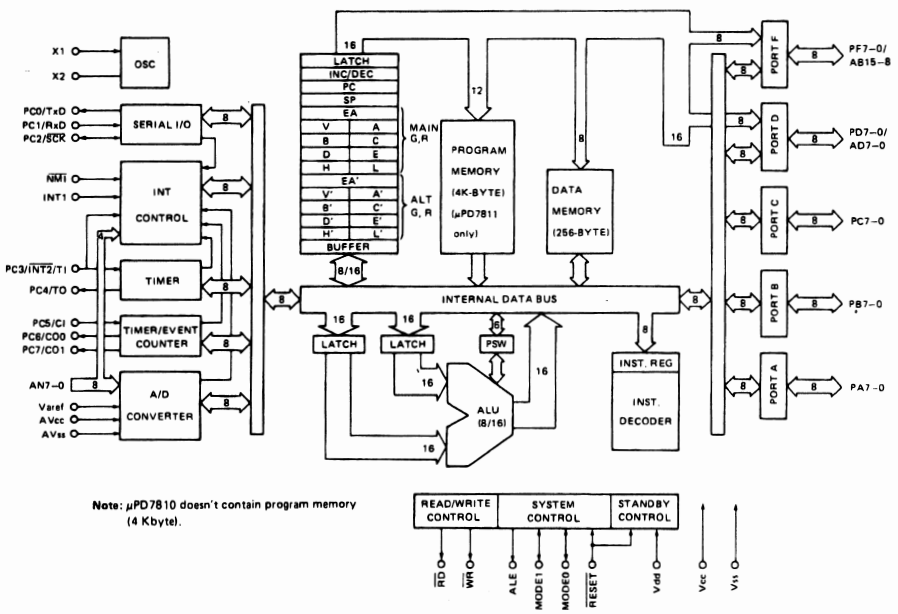
VCA BA6110

BLOCK DIAGRAM



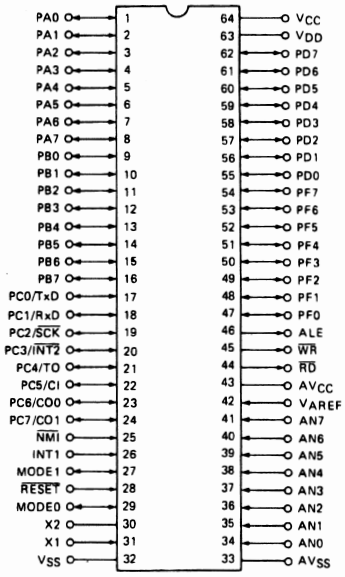
CPU μPD7810

BLOCK DIAGRAM



Note: μPD7810 doesn't contain program memory (4 Kbyte).

PIN CONFIGURATION

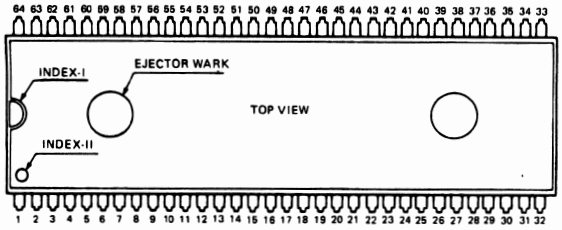


PIN NAMES

PA7–0	: Port A	X1, X2	: Crystal
PB7–0	: Port B	AN7–0	: Analog Input
PC7–0	: Port C	RD	: Read Strobe
PD7–0	: Port D	WR	: Write Strobe
PF7–0	: Port F	ALE	: Address Latch Enable
NMI	: Non Maskable Interrupt	RESET	: Reset
INT1	: Interrupt Request	VAREF	: Reference Voltage
MODE 0,1	: Mode 0, 1		

GATE ARRAY MB60H144

PIN CONFIGURATION



PIN DEFINITIONS

Pin no.	I/O	Pin name	Pin no.	I/O	Pin name	Pin no.	I/O	Pin name	Pin no.	I/O	Pin name
1	I	RESE	17	I/O	CPU2	33	I	COUT	49	O	WE
2	I	REC	18	I/O	CPU1	34	O	SH	50	O	C138
3	I	PROG	19	I/O	CPU0	35	O	DA12	51	O	B138
4	I	RCAN	20	I	CS	36	O	DA11	52	O	A138
5	I	BYIN	21	I	WR	37	O	DA10	53	O	A7
6	I	TRIG	22	I	RD	38	O	DA9	54	O	A1
7	O	BYPA	23	I	AD2	39	O	DA8	55	O	A5
8	I	INC1	24	I	AD1	40	O	DA7	56	O	A2
9	I	INC2	25	I	AD0	41	O	DA6	57	O	A4
10	I	TEST	26	O	PENA	42	O	DA5	58	O	A0
11	I/O	CPU7	27	O	CONP	43	O	DA4	59	O	A3
12	I/O	CPU6	28	O	DOFF	44	O	DA3	60	O	RAS
13	I/O	CPU5	29	O	SOFF	45	O	DA2	61	O	A6
14	I/O	CPU4	30	O	MUTE	46	O	DA1	62	I	DOUT
15	I/O	CPU3	31	I	CK1	47	O	CAS	63	O	DIN
16	–	VSS	32	–	VDD	48	–	VSS	64	–	VDD

Fujitsu CMOS Gate Array "H" Version Pin Assignment

10. PARTS LIST

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
	CARBON RESISTORS			
10113747	S1/4JT 4.7M	KLM-833		2
10416268	1/6JTP 68Ω			10
10416310	1/6JTP 100Ω			1
10416316	1/6JTP 160Ω			1
10416322	1/6JTP 220Ω	KLM-832		3
10416322	1/6JTP 220Ω	KLM-833		3
10416327	1/6JTP 270Ω	KLM-832		1
10416333	1/6JTP 330Ω	KLM-833		1
10416351	1/6JTP 510Ω			3
10416375	1/6JTP 750Ω			3
10416382	1/6JTP 820Ω			3
10416410	1/6JTP 1.0K	KLM-832		4
10416410	1/6JTP 1.0K	KLM-833		10
10416411	1/6JTP 1.1K			1
10416412	1/6JTP 1.2K			1
10416413	1/6JTP 1.3K			1
10416422	1/6JTP 2.2K			2
10416424	1/6JTP 2.4K			4
10416427	1/6JTP 2.7K			1
10416430	1/6JTP 3.0K			2
10416433	1/6JTP 3.3K			8
10416443	1/6JTP 4.3K			1
10416447	1/6JTP 4.7K	KLM-832		3
10416447	1/6JTP 4.7K	KLM-833		7
10416451	1/6JTP 5.1K			1
10416456	1/6JTP 5.6K			1
10416462	1/6JTP 6.2K			1
10416475	1/6JTP 7.5K			1
10416482	1/6JTP 8.2K			3
10416510	1/6JTP 10K	KLM-832		2
10416510	1/6JTP 10K	KLM-833		52
10416512	1/6JTP 12K			6
10416515	1/6JTP 15K			1
10416518	1/6JTP 18K			2
10416520	1/6JTP 20K			1
10416522	1/6JTP 22K	KLM-832		2
10416522	1/6JTP 22K	KLM-833		10
10416527	1/6JTP 27K			3
10416530	1/6JTP 30K			3
10416533	1/6JTP 33K			4
10416536	1/6JTP 36K			1
10416539	1/6JTP 39K			4
10416547	1/6JTP 47K			2
10416551	1/6JTP 51K			2
10416556	1/6JTP 56K			1
10416562	1/6JTP 62K	KLM-833		3
10416568	1/6JTP 68K			4
10416582	1/6JTP 82K			3
10416591	1/6JTP 91K	KLM-832		3
10416591	1/6JTP 91K	KLM-833		1
10416610	1/6JTP 100K			13
10416611	1/6JTP 110K	KLM-832		2
10416615	1/6JTP 150K	KLM-833		1
10416616	1/6JTP 160K			1
10416618	1/6JTP 180K			1
10416620	1/6JTP 200K			1
10416622	1/6JTP 220K			3
10416627	1/6JTP 270K			1
10416633	1/6JTP 330K			3
10416647	1/6JTP 470K			1
10416656	1/6JTP 560K			1
10416662	1/6JTP 620K			2
10416710	1/6JTP 1.0M			3
10509000	YLC 0Ω	KLM-832		11
	METAL FILM RESISTOR			
12516100	1/6TP 100K	KLM-833		1
	BLOCK RESISTORS			
13505510	RKC1/8B5J 10K	KLM-833		1
13506510	RKC1/8B6J 10K			2
13508510	RKC1/8B8J 10K			1
13509510	RKC1/8B9J 10K			1
13510433	RKC1/8B10J 3.3K			1
13807001	RKM7L502G			4
	MYLAR CAPACITORS			
20401410	50V 0.001μF	KLM-833		1
20401427	50V 0.0027μF			2
20401522	50V 0.022μF			3
20401533	50V 0.033μF			2
20401547	50V 0.047μF			1
20401568	50V 0.068μF			1
20402410	50V 0.001μF			2
20402468	50V 0.0068μF			1
20402512	50V 0.012μF			1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
CERAMIC CAPACITORS				
21226318	50V 180pF J	KLM-833		1
21356100	25V 0.1μF	KLM-829		3
21451500	50V 5pF TP	KLM-833		6
21452100	50V 10pF TP			4
21452330	50V 33pF TP			2
21452470	50V 47pF TP			2
21453220	50V 220pF TP	KLM-832		1
21453220	50V 220pF TP	KLM-833		2
21453680	50V 680pF TP			2
21454100	50V 1000pF TP			2
21455100	50V 0.01μF TP			2
21456100	25V 0.1μF TP	KLM-832		3
21456100	25V 0.1μF TP	KLM-833		37
SPARK KILLER				
21900300	PME265MC 533	KLM-829		1
TAMTALUM CAPACITORS				
22424147	25V 4.7μF-M	KLM-833		1
22425022	35V 0.22μF			2
ELECTROLYTIC CAPACITORS				
23507322	16V 220μF	KLM-829		1
23507347	16V 470μF			2
23507410	16V 1000μF			1
23513410	35V 1000μF			2
25402310	10V 100μF	KLM-833		5
25403247	16V 47μF	KLM-832		1
25403247	16V 47μF	KLM-833		14
25404147	25V 4.7μF			11
25404210	25V 10μF	KLM-832		4
25404210	25V 10μF	KLM-833		48
25464168	25V 6.8μF			1
25466047	50V 0.47μF			1
25466110	50V 1μF			1
TRANSISTORS				
30400020	2SA1175 K TN	KLM-833		8
30420020	2SC2785 K TN	KLM-832		1
30420020	2SC2785 K TN	KLM-833		14

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
30420060	2SC-1959Y	KLM-832		2
30420060	2SC-1959Y	KLM-833		1
DIGITAL TRANSISTOR				
30430040	DTC-114Y	KLM-833		1
DIODES				
31001500	SR1K-2	KLM-829		11
31001500	SR1K-2	KLM-832		1
31001500	SR1K-2	KLM-833		1
31401300	1SS-133	KLM-832		1
31401300	1SS-133	KLM-833		35
LEDs				
31201400	PR 3932S	KLM-831		2
31203900	SLB-26VR3F RED	KLM-825		1
31204000	SLB-26MG3F GREEN			2
31205000	LN513RA RED	KLM-831		4
31205100	LN513GA GRN			2
31205200	SLB-26DU3F	KLM-825		1
ZENER DIODES				
31420200	RD-5.1EB-TN-B2	KLM-833		3
31421400	RD-12-T1-B2			1
31421700	RD7.5-T1-B2			2
ICs				
32001023	μPD-4066BC	KLM-833	Quad analog switch	1
32001048	μPD-4164C-3		65536 bit dynamic RAM	8
32001059	μPD-4538BC		Dual precision retrigger able monostable multivibrator	1
32001071	74HC (40H) 138C		3-line to 8-line decoder	4
32001073	74HC (40H) 373C		Octal D type latch with 3 state output	1
32001074	μPD6360C		Dual analog switch	1
32001076	μPD7810CW		CPU	1
32002019	AN-6878		LED driver	1
32002155	74HC (40H) 273		Octal D type flip-flop	1
32004020	HD-14174 BP		Hex D type flip-flop	4
32004030	HA-17408P		8 bit DAC	1
32004039	HD-14053BP		Analog multiplexer	10
32007016	BA6110		VCA	1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
32007017	BA9221	KLM-833	12 bit DAC	1
32009001	NJM-4558D-V		OP AMP	5
32009004	NJM-78L05A		Regulator for DAC	1
32009012	NJM-311D		Comparator	1
32009022	NJM-4558D-D		OP AMP	1
32009032	NJM-78M05A	KLM-829	Power regulator (+5V)	1
32009033	NJM-78M15A		Power regulator (+15V)	1
32009034	NJM-79M15A		Power regulator (–15V)	1
32011020	M5224P	KLM-833	OP AMP	2
32011024	M-5223		OP AMP	1
32012002	MB-8416-20LP		16384-bit RAM	1
32012003	MBM-2764-25Z		65536-bit EPROM	1
32012011	MB60H144		Gate array	1
32013001	PST-518		Reset	1
32021011	TL-072		OP AMP	2
32021036	SN-74LS624		VCO	1
32021046	SN74HC393		Dual 4 bit binary counter	1
32025002	NE-571		Compander	1
PHOTO COUPLER				
33001000	TLP-552	KLM-832		1
CERAMIC OSCILLATOR				
33501700	KBR-12.0MHz	KLM-833		1
P.C. BOARD WITH PARTS				
34082510	KLM-825	KLM-825		1
34082910	KLM-829	KLM-829		1
34083100	KLM-831	KLM-831		1
34083200	KLM-832	KLM-832		1
34083300	KLM-833	KLM-833		1
SEMI FIXED VRs				
35001310	H0651A 10KB	KLM-833		5
35001347	H0651A 47KB			1
35001410	H0651A 100KB			2
VRs				
36019000	K09110A25 10KB	KLM-832		1
36019100	K1611008TE 20KB			2
ROTARY ENCODER				
37003100	LA22658			1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
SLIDE SW				
37305400	SLS-25-2042	KLM-832		1
TACT SWs				
37504800	KEC-10010	KLM-831		1
37504900	KEC-11903			13
POWER SW				
37506100	Power SW SDL-1P			1
POWER TRANSFORMERS				
40008900	TA-802		100V	1
40008900	TA-802		UNI	1
40008900	TA-802		JAM	1
40008900	TA-802		117 2P	1
40009000	TB-802		220 GE	1
40009000	TB-802		220 SE	1
40009000	TB-802		240 AF	1
40009000	TB-802		240 AU	1
40009000	TB-802		DEMKO	1
40009000	TB-802		SEMKO	1
40009000	TB-802		NEMKO	1
40009000	TB-802		240 GE	1
40009000	TB-802		GAF	1
40009000	TB-802		FIMKO	1
40009000	TB-802		240 RME	1
40009000	TB-802		VDE	1
LOW PASS FILTERS				
40202000	PFB-3-4500-01	KLM-833		2
40202100	FB-22-0527-06			2
RELAYS				
40300800	FR-644D05/1AS	KLM-833		1
40300900	FR-644D05/2AS	KLM-832		1
PHONE JACKS				
45402000	HLJ0520-01-110			8
45402100	HLJ0520-01-010			1
SNAP PLATES				
45402400				4

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
		FUSES		
46402301	125V 2A UL		100V	1
46402301	125V 2A UL		UNI	1
46402301	125V 2A UL		JAM	1
46402301	125V 2A UL		117 2P	1
46411701	250V 0.5A UL		100V	1
46411701	250V 0.5A UL		UNI	1
46411701	250V 0.5A UL		JAM	1
46411701	250V 0.5A UL		117 2P	1
46412003	250V 1.0A UL		100V	2
46412003	250V 1.0A UL		UNI	2
46412003	250V 1.0A UL		JAM	2
46412003	250V 1.0A UL		117 2P	2
46461501	250V T315MA		220 GE	1
46461501	250V T315MA		220 SE	1
46461501	250V T315MA		240 AF	1
46461501	250V T315MA		240 AU	1
46461501	250V T315MA		DEMKO	1
46461501	250V T315MA		SEMKO	1
46461501	250V T315MA		NEMKO	1
46461501	250V T315MA		240 GE	1
46461501	250V T315MA		GAF	1
46461501	250V T315MA		FIMKO	1
46461501	250V T315MA		240 RME	1
46461501	250V T315MA		VDE	1
46461701	250V T500MA		220 GE	2
46461701	250V T500MA		220 SE	2
46461701	250V T500MA		240 AF	2
46461701	250V T500MA		240 AU	2
46461701	250V T500MA		DEMKO	2
46461701	250V T500MA		SEMKO	2
46461701	250V T500MA		NEMKO	2
46461701	250V T500MA		240 GE	2
46461701	250V T500MA		GAF	2
46461701	250V T500MA		FIMKO	2
46461701	250V T500MA		240 RME	2
46461701	250V T500MA		VDE	2
46462001	250V T1.0A		220 GE	1
46462001	250V T1.0A		220 SE	1
46462001	250V T1.0A		240 AF	1
46462001	250V T1.0A		240 AU	1
46462001	250V T1.0A		DEMKO	1
46462001	250V T1.0A		SEMKO	1
46462001	250V T1.0A		NEMKO	1
46462001	250V T1.0A		240 GE	1
46462001	250V T1.0A		GAF	1
46462001	250V T1.0A		FIMKO	1
46462001	250V T1.0A		240 RME	1
46462001	250V T1.0A		VDE	1
		HARNESSES		
47093800	HNS-838			1
47093900	HNS-839			1
47094000	HNS-840			1
47094100	HNS-841			1
47094200	HNS-842			1
47094300	HNS-843			1
47094400	HNS-844			1
47094500	HNS-845			1
47094600	HNS-846			1
47094700	HNS-847	KLM-832		1
47094800	HNS-848			1
47094900	HNS-849			1
		CONNECTOR TOPS		
47130300	B3B-XHA	KLM-833		3
47130400	B4B-XHA			2
47130500	B5B-XHA	KLM-829		1
47130500	B5B-XHA	KLM-833		2
47130600	B6B-XHA			1
47130900	B9B-XHA	KLM-832		1
47130900	B9B-XHA	KLM-833		1
47131000	B10B-XHA			1
47131300	B13B-XHA			1
47131400	B14B-XHA			1
		BASE PIN		
47407301	RTB-1.5-5	KLM-829		1
		IC SOCKET		
48001282	28P DICA-28CTI	KLM-833		1
		DIN SOCKETS		
48010190	TCS4650-01-1211	KLM-832		2

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
	RUBBER FEETS			
50007800	25x25x4.5			4
	FUSE HOLDERS			
51501600	S-N5053 #01	KLM-829		8
	LITHIC BATTERY			
52001300	CR2032-FT			1
	BUSHINGS			
54000300	SR-4K-4		100V	1
54000300	SR-4K-4		UNI	1
54000300	SR-4K-4		117 2P	1
54000400	SR-5P-4		240 AU	1
54000500	SR-6W-1		220 GE	1
54000500	SR-6W-1		220 SE	1
54000500	SR-6W-1		240 AF	1
54000500	SR-6W-1		DEMKO	1
54000500	SR-6W-1		SEMKO	1
54000500	SR-6W-1		NEMKO	1
54000500	SR-6W-1		240 GE	1
54000500	SR-6W-1		GAF	1
54000500	SR-6W-1		FIMKO	1
54000500	SR-6W-1		240 RME	1
54000500	SR-6W-1		VDE	1
54000501	SR-6N3-4		JAM	1
	WIRE BANDS			
54005300	SKM-1			1
54007200	PLT-1M			10
	TEST PINS			
54007100	LC-2-G-YELLOW	KLM-833		4
	ISOLATING WASHERS			
54007300	B-1725K	KLM-829		2

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
	CORD BAND			
54007600	No.113 BLACK			1
	PLASTIC RIVETS FOR DIN JACK			
54011000				4
	RADIATION MASK			
55005100	120x105			1
	RADIATION SHEETS			
56500300	BFG-30	KLM-829		3
	LED HOLDERS			
57502200	3x6x5.5	KLM-831		2
	AC CORDS			
60000102	KE-1044B PVC.75		100V	1
60000201	SPT-2 18AWG SU426-58		UNI	1
60000201	SPT-2 18AWG SU426-58		117 2P	1
60000301	CLASS1 (SU429-58)		220 GE	1
60000301	CLASS1 (SU429-58)		DEMKO	1
60000301	CLASS1 (SU429-58)		SEMKO	1
60000301	CLASS1 (SU429-58)		NEMKO	1
60000301	CLASS1 (SU429-58)		240 GE	1
60000301	CLASS1 (SU429-58)		FIMKO	1
60000301	CLASS1 (SU429-58)		240 RME	1
60000301	CLASS1 (SU429-58)		VDE	1
60000401	SAA (SU428-58) 3x.75		240 AU	1
60000501	BS PLUG (SU431A-58)		240 AF	1
60000901	SEV (SU430-58)		220 SE	1
60001301	KP-4819D GTCE-3.75		GAF	1
60002000	SJT (SU338-56) 18/3MM		JAM	1
	ROTARY VR (SW) KNOB			
62007400	SMALL			1
	TACT SW KNOBS			
62011000	KT-8			12

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
62011001	KT-8			1
62011202	RED			1
POWER SW KNOB				
62011100	SUE55102			1
VR KNOB				
62013200				3
SHIELDING PLATE				
63000300				1
LED FILTER				
63001000	AL-602 T-4			1
METAL FITTING OF FRONT PANEL				
64063600	L			1
64063601	R			1
FRONT PANEL BOARDS				
64063700				2
HEAT SINK				
64063800		KLM-829		1
METAL FITTING OF BUSHING				
64064000	NO1		100V	1
64064000	NO1		UNI	1
64064000	NO1		117 2P	1
64064000	NO1		220 GE	1
64064000	NO1		220 SE	1
64064000	NO1		240 AF	1
64064000	NO1		240 AU	1
64064000	NO1		DEMKO	1
64064000	NO1		SEMKO	1
64064000	NO1		NEMKO	1
64064000	NO1		240 GE	1
64064000	NO1		GAF	1
64064000	NO1		FIMKO	1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
64064000	NO1		240 RME	1
64064000	NO1		VDE	1
64064100	NO2		JAM	1
FRONT PANEL				
64069200				1
CHASSIS				
64069300				1
FRONT CHASSIS				
64069400				1
COVER				
64069500				1
METAL FITTING OF PHONE JACK				
64069600				1
NAME PLATES				
68600700			UNI	1
68600700			JAM	1
68600700			117 2P	1
68600700			220 GE	1
68600700			220 SE	1
68600700			240 AF	1
68600700			240 AU	1
68600700			DEMKO	1
68600700			SEMKO	1
68600700			NEMKO	1
68600700			240 GE	1
68600700			GAF	1
68600700			FIMKO	1
68600700			240 RME	1
68600700			VDE	1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
		SCREWS		
70060512	FE P BZMC 5x12			4
70530306	FE B ZMC 3x6			26
70530308	FE B ZMC 3x8	KLM-829		5
70530408	FE B ZMC 4x8			1
70560310	FE B BZMC 3x10			5
72160308	TP2G F BZMC 3x8			4
72560306	TP2G B BZMC 3x6			24
		NUTS		
77030300	FHN ZMC 3			5
77030400	FHN ZMC 4			1
77130300	HN1 ZMC 3	KLM-829		3
		WASHERS		
78060500	WM BZMC 5x12			4
78160400	WK BZMC 4			4
78430400	TWU ZMC 4		JAM	1
78430400	TWU ZMC 4		220 GE	1
78430400	TWU ZMC 4		220 SE	1
78430400	TWU ZMC 4		240 AF	1
78430400	TWU ZMC 4		240 AU	1
78430400	TWU ZMC 4		DEMKO	1
78430400	TWU ZMC 4		SEMKO	1
78430400	TWU ZMC 4		NEMKO	1
78430400	TWU ZMC 4		240 GE	1
78430400	TWU ZMC 4		GAF	1
78430400	TWU ZMC 4		FIMKO	1
78430400	TWU ZMC 4		240 RME	1
78430400	TWU ZMC 4		VDE	1
		VR HOLDER		
79022102	10x7x2 BSBM			1
		SCREWS W/HEX HOLE		
79090408	4x8 BZMC			4